

(19) World Intellectual Property
Organization
International Bureau



28 MAR 2005



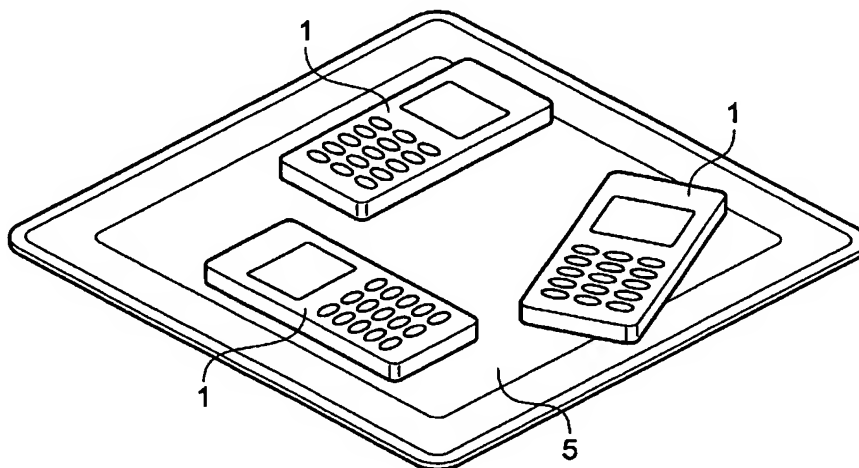
(43) International Publication Date
8 April 2004 (08.04.2004)

PCT

(10) International Publication Number
WO 2004/030176 A2

- (51) International Patent Classification⁷: **H02J 7/00**
- (21) International Application Number:
PCT/GB2003/004150
- (22) International Filing Date:
26 September 2003 (26.09.2003)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
0222436.8 27 September 2002 (27.09.2002) GB
- (71) Applicant (for all designated States except US): **SPLASH-POWER LIMITED** [GB/GB]; St. John's Innovation Centre, Cowley Road, Cambridge CB4 0WS (GB).
- (72) Inventors; and
- (75) Inventors/Applicants (for US only): **BEART, Pilgrim, Giles, William** [GB/GB]; 35 Royston Road, Harston, Cambridge CB2 5NH (GB). **CHENG, Lily, Ka, Lal** [CA/GB]; 53 College Fields, Woodhead Drive, Cambridge CB4 1YZ (GB).
- (74) Agent: **HASELTINE LAKE**; Imperial House, 15-19 Kingsway, London WC2B 6UD (GB).
- (81) Designated States (national): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.
- (84) Designated States (regional): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).
- Declaration under Rule 4.17:**
— of inventorship (Rule 4.17(iv)) for US only
- Published:**
— without international search report and to be republished upon receipt of that report
- For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: IMPROVEMENTS RELATING TO RETENTION OF RECHARGEABLE DEVICES



(57) Abstract: There is disclosed a system and method for retaining portable rechargeable devices to recharging stations wherein one or other or both of the recharging station and the portable device are provided with connecting means adapted for temporary releasable connection of the two. This is particularly advantageous when used with recharging stations, which permit the device to be recharged in multiple places on the recharging station, providing a positive means of retaining the device. This is particularly advantageous if the recharging station is to be used in a mobile environment such as a car, or on a wall or ceiling.

**IMPROVEMENTS RELATING TO RETENTION OF RECHARGEABLE
DEVICES**

This invention relates to a new system for temporary attachment of portable
5 rechargeable devices to recharging stations, and a method of temporarily attaching
portable rechargeable devices to their charging units.

Today's portable rechargeable devices are typically recharged by temporarily
connecting them to a recharger via a mating plug-in or clip-on connection. An
10 example is the typical "floating wire" connection between a mains charger and a
mobile phone (see Figure 1).

The connection serves two purposes:

- 1) It electrically connects the device to its recharger, allowing transfer of power.
- 15 2) It mechanically connects the device to its recharger, in a way which retains it
securely against forces from accidental knocks and the like, but is easily
removable by the user. This mechanical connection thus allows recharging to
continue reliably until the user physically breaks the connection, and in some
cases may also keep the device conveniently available to the user. Examples of
20 the latter include the recharging "cradle" for the Palm Pilot® and the drop-in
"hands-free" car socket for a mobile phone.

Some of today's portable rechargeable devices are charged by a non-contact means,
for example by inductive power transfer. An example is the Braun® electric
25 toothbrush, where the toothbrush must be accurately located onto a spigot on the
recharger, which retains it. However, the spigot serves only as a positioning means
and no additional force is required to separate the toothbrush from the charger other
than that required to lift the toothbrush against gravity.

30 But some of these non-contact charging means do not require the device and the
recharger to be so precisely aligned. Such solutions may offer significant freedoms
for the designer and for the user. For example the recharging means may be a

laminar surface upon which a device can conveniently be placed, in any position and any orientation, as disclosed, for example, in the present applicant's UK patent application no. 01283175 of 27 November 2001. This avoids the limitations of the positive mechanical connection (e.g. cradles, connectors, clips) required by other charging solutions, and so is more convenient to the user because it is easier to place a device casually anywhere on a surface than precisely to align it with a mechanical socket. Dispensing with the need for mechanical location may also allow other benefits, such as the ability simultaneously to recharge multiple units, and/or to recharge devices of different types on the same recharger.

However in some situations, the lack of positive mechanical retention of such a surface may be a disadvantage for users. For example:

- A flat recharging surface must be kept substantially horizontal to prevent devices from sliding off the surface. But this requirement may be inconvenient to the user – for example putting the surface on a desk may occupy otherwise-useful space. Freeing-up the surface so that it can be placed in any orientation would give the user much more flexibility to use otherwise-useless space – for example to mount the surface vertically on a wall, or even on the inside of a car roof.
- If a mobile recharging surface is likely to be subject to movement (e.g. a tabletop that may get knocked, or in a car, aeroplane or spacecraft), the devices may fall off.

Clearly, it would be convenient to remove these potential disadvantages whilst preserving the benefits of freedom of design and use of such surface-based charging systems.

According to a first aspect of the present invention there is provided a system for wireless powering or recharging of rechargeable devices, the system comprising a charging unit and a power receiving device, wherein one or other or both of the charging unit and the power receiving device is provided with connecting means

adapted for temporary releasable connection of the power receiving device to the charging unit, the connecting means not being an electrical connection.

5 According to a second aspect of the invention, there is provided a system for wireless powering or recharging of rechargeable devices, the system comprising a charging unit and a power receiving device, wherein one or other or both of the charging unit and the power receiving device is provided with connecting means adapted for temporary releasable connection of the power receiving device to the charging unit in at least two positions and/or rotations of the device relative to the charging unit.

10

According to a third aspect of the invention, there is provided a charging unit adapted for wireless powering or recharging of a power receiving device, wherein the charging unit is provided with connecting means for temporary releasable connection of a power receiving device thereto, the connecting means not being an electrical connection.

15

According to a fourth aspect of the present invention, there is provided a power receiving device adapted for wireless powering or recharging by a charging unit, wherein the power receiving device is provided with connecting means for temporary releasable connection of a charging unit thereto, the connecting means not being an electrical connection.

20

According to a fifth aspect of the present invention, there is provided a method of wireless powering or recharging of a power-receiving device which comprises temporarily attaching the device to a charging unit, said method further comprising utilising a releasable temporary connecting means attached to the charging unit and/or the device, wherein said connecting means is adapted to enable the charging unit and the device to be attached in one or more positions and/or orientations relative to each other, the connecting means not being an electrical connection.

25

30

Accordingly, embodiments of the present invention provides a system for powering or recharging rechargeable devices which has several advantages over the prior art.

Such a system is advantageous because it provides convenient retention of the device to the charging unit while still preserving the convenience of being able to simply drop or press the device against the charging unit, thus greatly expanding the number of usable places for the user to locate the charging unit.

5

It is to be appreciated that embodiments of the present invention are distinguished over existing systems and methods in that there is provided a combination of wireless power transfer and a temporary releasable connection. Ordinary wired power transfer systems generally incorporate a releasable physical connection such as a plug and socket with physical mating means, but these are provided in order to secure a good electrical connection. Ordinary wireless power transfer systems, on the other hand, do not incorporate physical, temporary releasable physical connections, since these have hitherto been seen as disadvantageous in a wireless system. For the avoidance of doubt, it is hereby stated that the expression “temporary releasable connection” is intended to cover connections that require a predetermined degree of force for separation. In other words, a simple location spigot such as found in wireless electric toothbrush chargers is not intended to be covered by the term “temporary releasable connection”, since no particular force is required to separate the toothbrush from the charger. Embodiments of the present invention therefore combine a releasable physical connection with a wireless power transfer system in a counterintuitive way that is not suggested by the prior art.

10
15
20

Preferably, the power receiving device is portable. Examples of portable power receiving devices include mobile telephones, lap-top computers, and personal digital assistants (PDA).

25

Examples of relative positions and/or orientations in which the charging unit and device may be attached include:

- Any position in one translational dimension.
- Any position in an orthogonal translational dimension.
- Any rotation about one plane.
- Any rotation about a plane orthogonal to the first.

30

- Any combination of the above.

It will be understood that the term “recharging” may also be taken to mean “powering” for devices which do not have substantial rechargeable batteries, and therefore can only operate while in proximity to the recharger, for example lightbulbs, fans etc.

Preferably, the charging unit is capable of charging multiple types of device.

10 Preferably, the charging unit is capable of charging multiple devices simultaneously.

Preferably, the device is capable of being charged by multiple types of charging unit.

Advantageously, the connecting means comprises a means added to the surface of the device and/or the charging unit. Examples of this type of connecting means include hook-and-eye fasteners (such as Velcro™), suckers, reusable, self-adhesive glue (as used in, for example, Post-It™ notes) or high stiction/friction surfaces such as a rubbery or rough surface. The means may cover only a small portion of the surface, or for example a complete face, or the entire device and/or charging unit.

20 Alternatively or in addition, the connecting means may comprise a shaping of the surface of the device and/or the charging unit. Examples of the connecting means used in this embodiment of the invention include bumps, ridges or grooves on the surface of either the charging unit or the device. For example, the connecting means may comprise a plurality of projections on one surface and a plurality of corresponding holes on another surface, for example as used in Lego® building blocks. Alternatively, spiked systems such as those exemplified by Stickle-Bricks(R) or spikes with corresponding holes can be used as connecting means. Hook-and-eye shapings may also be used as connecting means.

30 Alternatively or in addition, the connecting means may comprise means added beneath the surface of the device and/or the charging unit, said means being capable

of acting at a distance. Examples of the connecting means in this embodiment of the invention may include permanent magnets, and arrays of such, electromagnets, and arrays of such or possibly electrostatically-charged terminals.

- 5 Alternatively or in addition, only the charging unit, and not the device comprises a connecting means. In this embodiment, examples of the connecting means include pockets. For example, the charging unit may be positioned so that it hangs vertically on a wall and the connecting means of the charging unit may be multiple pockets to receive one or more devices. Further examples of the connecting means of the
- 10 charging unit may include elastic bands to strap down the device(s), or indentations or contours on the charging unit. Examples of such indentations or contours on the charging unit include a ridge designed to hold standard AA cells for example or a bowl shape indentation to retain a variety of differently-shaped devices.
- 15 In one embodiment, the connecting means may be adapted to enable the charging unit and the device to be mated in a large number of different relative orientations, for example, such that the possible relative location and rotation of the device and charging unit are quantised into so many possibilities that there is no limitation visible to the user. For example, the connecting means could be Velcro®, which
- 20 would enable mating between the charging unit and the device to occur in almost any position and rotation relative to each another. Alternatively, the connecting means may be adapted to enable the charging unit and the device to be mated in a limited number of relative orientations only. For example, the connecting means may comprise a plurality of projections on one surface and a plurality of corresponding
- 25 holes on another surface, such as Lego® building blocks, which may only allow mating between the charging unit and the device in a maximum of four possible rotations and at a finite number of discrete locations).

- In particular, there may only be one possible relative orientation in which the device
- 30 and charging unit may be mated together. For example, a manufacturer selling a device capable of being recharged by relatively large recharging surfaces may nevertheless choose to include with the device a small, low-cost recharging surface

which precisely fits the device, and is retained to it, for example by 4 holes in the device and 4 corresponding bumps in the surface. Thus the user can “clip” the surface of the charging unit to the device in a manner similar to today’s wired charging connections, but the device is capable of being used more flexibly with larger charging unit surfaces. In this case, the surface may be incorporated directly into a mains-powered charging unit, providing a low-cost “no wires” easy-travel solution onto which a device can be conveniently pressed.

The connecting means of the device may correspond to the connecting means of the charging unit, such that devices will attach to charging units, but not devices to devices nor charging units to charging units. An example of a connecting means of this embodiment is Velcro® which comes in “male” and “female” types which stick to each other but not to themselves. Thus, the connecting means of the device may be Velcro® of the male type, and the connecting means of the charging unit may be Velcro® of the female type.

Alternatively, the connecting means of the charging unit may be identical to the connecting means of the device. This embodiment will be capable of attaching to itself and may be used on all devices and charging units. An example is a reusable tacky adhesive such as the glue used in Post-It® notes. A potential advantage of this is in the case where a device is capable of performing the function of a charging unit to another device.

In a yet further embodiment, there may be several different classes of pairs of types of connecting means, with each pair class attaching only to the other of the pair. A potential advantage of this is in the case that not all charging units are capable of recharging all devices – a user can then immediately feel that a device is not “sticking” to a (or part of a) charging unit and will not be recharged by it.

In addition to the embodiments described above, the connecting means may in addition possess aesthetic or visual qualities to conveniently inform users that a device is capable of being recharged, or a charging unit is available to recharge, or if

a certain (part of the) charging unit is more appropriate for charging a particular class of device in the manner described above.

Examples of these qualities include giving the connecting means:

- 5
 - A specific reflective colour (e.g. Pantone® 123)
 - A specific emissive colour (e.g. a bright red light)
 - A fluorescent or luminous colour
 - A specific "sheen" (e.g. glittering metallic silver)
 - A specific repeated pattern (e.g. triangles)
- 10
 - A specific logo design or text (e.g. "Zap™")
 - An outline of the area in which a device may receive power
 - A texture, which may optionally be recognisable by touch alone (e.g. fuzzy)
 - A material

or combinations of the above.

15

These aesthetic qualities may even be used to inform users of the presence of devices or charging units in places where they would not otherwise suspect them, for example a charging unit embedded within part of a tabletop.

- 20 The aesthetic qualities may change their appearance or touch depending on the state of the device and/or the charging unit. For example the surface of a device and/or charging unit may change colour when it is powered-on, or the device is in need of recharging, or is recharging, or is recharged, or is in need of attention (for example a mobile phone device receiving an incoming call).

25

The preferred features of the invention are applicable to all aspects of the invention and may be used in any possible combination.

- 30 Throughout the description and claims of this specification, the words "comprise" and "contain" and variations of the words, for example "comprising" and "comprises", mean "including but not limited to", and are not intended to (and do not) exclude other components, integers, moieties, additives or steps.

For a better understanding of the present invention and to show it may be carried into effect, reference shall now be made, by way of example, to the accompanying drawings, in which:

5

FIGURE 1 shows an example of a prior art recharging connection;

FIGURE 2 shows an embodiment of the present invention; and

10 FIGURE 3 shows an alternative embodiment of the present invention.

Referring to Figure 3, there is shown a power receiving device 1, in this embodiment the device is a mobile phone. The mobile phone 1 has a connecting means 3 attached to the back of the phone. In this embodiment the connecting means 3 of the device 1
15 is a patch of self-adhesive Velcro® of the “male” type. This is black and slightly prickly, informing the user that the phone may be charged on a charging surface. Figure 3 also shows a charging unit 5. In this embodiment the charging unit 5 is an inductive recharging pad. On the surface 7 of the pad 5 is attached a patch of self-adhesive Velcro® of the “female” type 9, which acts as the connecting means of the
20 charging unit. This is black and slightly fuzzy, informing the user that the pad may charge devices.

To mate the phone 1 and the pad 5 temporarily, the user simply presses the phone 1 onto the pad 5 (or drops it, if the pad is below the phone) and the Velcro® 3, 9 holds
25 the phone in place on the pad . The phone can be placed onto the pad in any orientation and in any position, and is held securely by the Velcro®. Once the phone and the pad are attached in this way, the phone can receive power from the pad and so can be recharged. When the phone 1 has been recharged fully, or before if desired, it can be removed from the pad 5 easily by the user at any time, simply by pulling it
30 away. This disengages the Velcro® 3 from the Velcro® 9.

Figure 2 shows an alternative embodiment wherein a plurality of devices 1, (in this

embodiment, mobile phones) are attached to a charging unit 5 (in this embodiment, a pad). Figure 2 shows that, in this embodiment, the mobile phone 1 and the pad 5 can be mated at various different orientations to the each other and also the mobile phones can be positioned at different orientations relative to the other mobile phones

5 1.

CLAIMS:

1. A system for wireless powering or recharging of rechargeable devices, the system comprising a charging unit and a power receiving device, wherein one or
5 other or both of the charging unit and the power receiving device is provided with connecting means adapted for temporary releasable connection of the power receiving device to the charging unit, the connecting means not being an electrical connection.
- 10 2. A system as claimed in claim 1, wherein the connecting means is adapted for temporary releasable connection of the power receiving device to the charging unit in at least two positions and/or rotations of the device relative to the charging unit.
- 15 3. A system as claimed in claim 1 or 2, wherein the connecting means is selected from a group comprising: hook-and-eye fasteners, suckers, reusable self-adhesive glue, high stiction/friction surfaces, a shaped recess or projection or plurality thereof, a permanent magnet or array of permanent magnets, an electromagnet or array of electromagnets, and electrostatically-charged terminals.
- 20 4. A charging unit adapted for wireless powering or recharging of a power receiving device, wherein the charging unit is provided with connecting means for temporary releasable connection of a power receiving device thereto, the connecting means not being an electrical connection.
- 25 5. A charging unit as claimed in claim 4, wherein the connecting means is adapted for temporary releasable connection of the power receiving device to the charging unit in at least two positions and/or rotations of the device relative to the charging unit.
- 30 6. A charging unit as claimed in claim 4 or 5, wherein the connecting means is selected from a group comprising: hook-and-eye fasteners, suckers, reusable self-adhesive glue, high stiction/friction surfaces, a shaped recess or projection or

plurality thereof, a permanent magnet or array of permanent magnets, an electromagnet or array of electromagnets, and electrostatically-charged terminals.

7. A power receiving device adapted for wireless powering or recharging by a charging unit, wherein the power receiving device is provided with connecting means for temporary releasable connection of a charging unit thereto, the connecting means not being an electrical connection.

8. A power receiving device as claimed in claim 7, wherein the connecting means is adapted for temporary releasable connection of the power receiving device to the charging unit in at least two positions and/or rotations of the device relative to the charging unit.

9. A power receiving device as claimed in claim 7 or 8, wherein the connecting means is selected from a group comprising: hook-and-eye fasteners, suckers, reusable self-adhesive glue, high stiction/friction surfaces, a shaped recess or projection or plurality thereof, a permanent magnet or array of permanent magnets, an electromagnet or array of electromagnets, and electrostatically-charged terminals.

10. A method of wireless powering or recharging of a power-receiving device which comprises temporarily attaching the device to a charging unit, said method further comprising utilising a releasable temporary connecting means attached to the charging unit and/or the device, wherein said connecting means is adapted to enable the charging unit and the device to be attached in one or more positions and/or orientations relative to each other, the connecting means not being an electrical connection.

11. A method according to claim 10, wherein the connecting means is adapted for temporary releasable connection of the power receiving device to the charging unit in at least two positions and/or rotations of the device relative to the charging unit.

12. A method according to claim 10 or 11, wherein the connecting means is selected from a group comprising: hook-and-eye fasteners, suckers, reusable self-adhesive glue, high stiction/friction surfaces, a shaped recess or projection or plurality thereof, a permanent magnet or array of permanent magnets, an
5 electromagnet or array of electromagnets, and electrostatically-charged terminals.

13. A system for wireless powering or recharging of rechargeable devices, substantially as hereinbefore described with reference to or as shown in Figures 2 and 3 of the accompanying drawings.

10

14. A charging unit adapted for wireless powering or recharging of a power receiving device, substantially as hereinbefore described with reference to or as shown in Figures 2 and 3 of the accompanying drawings.

15 15. A power receiving device adapted for wireless powering or recharging by a charging unit, substantially as hereinbefore described with reference to or as shown in Figures 2 and 3 of the accompanying drawings.

16. A method of wireless powering or recharging of a power-receiving device,
20 substantially as hereinbefore described with reference to or as shown in Figures 2 and 3 of the accompanying drawings.

1/3

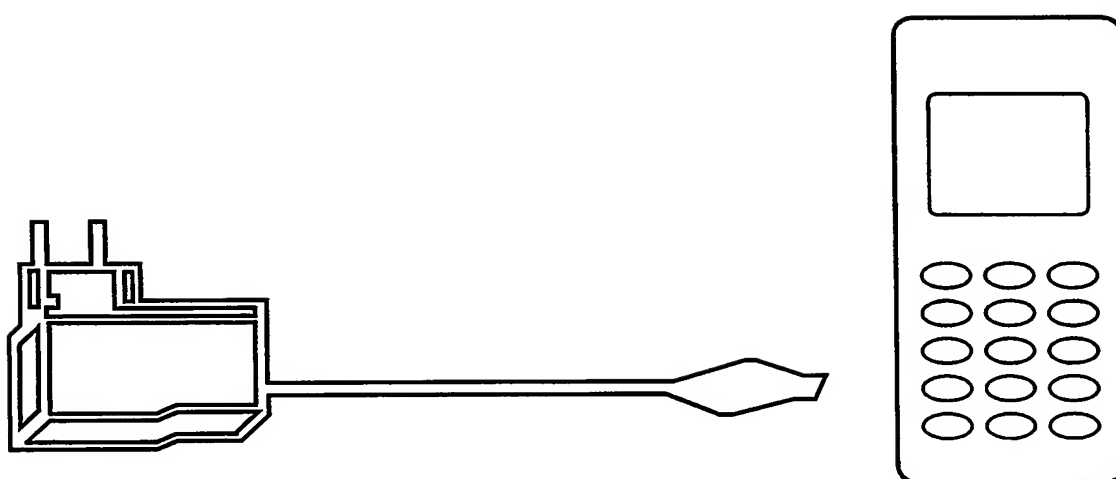


Fig. 1

2/3

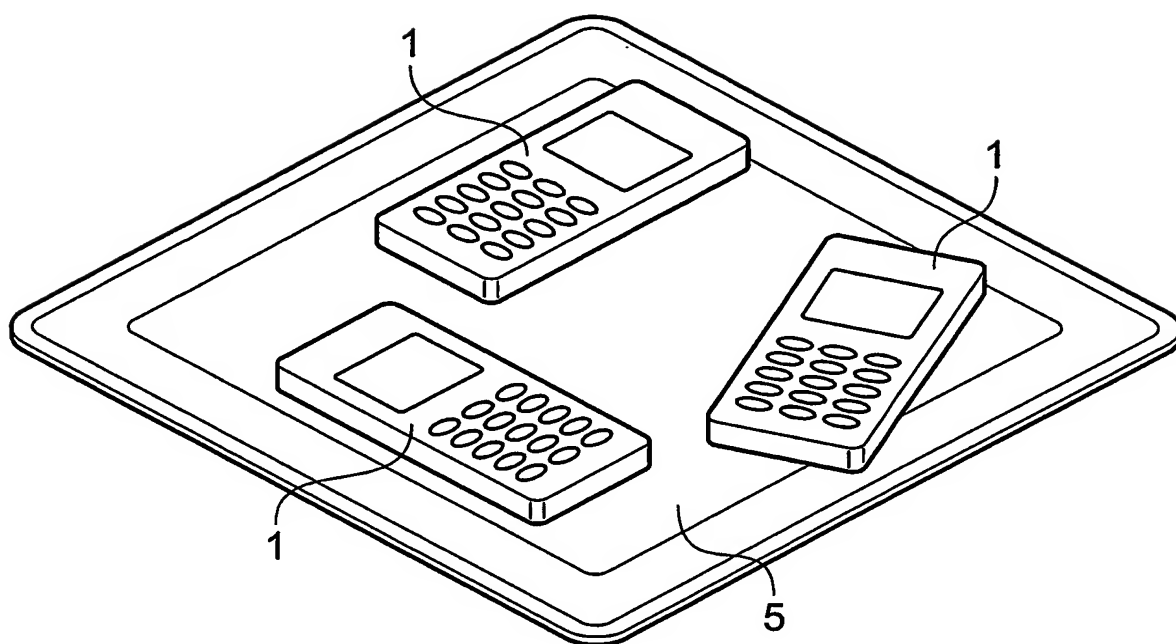


Fig. 2

3/3

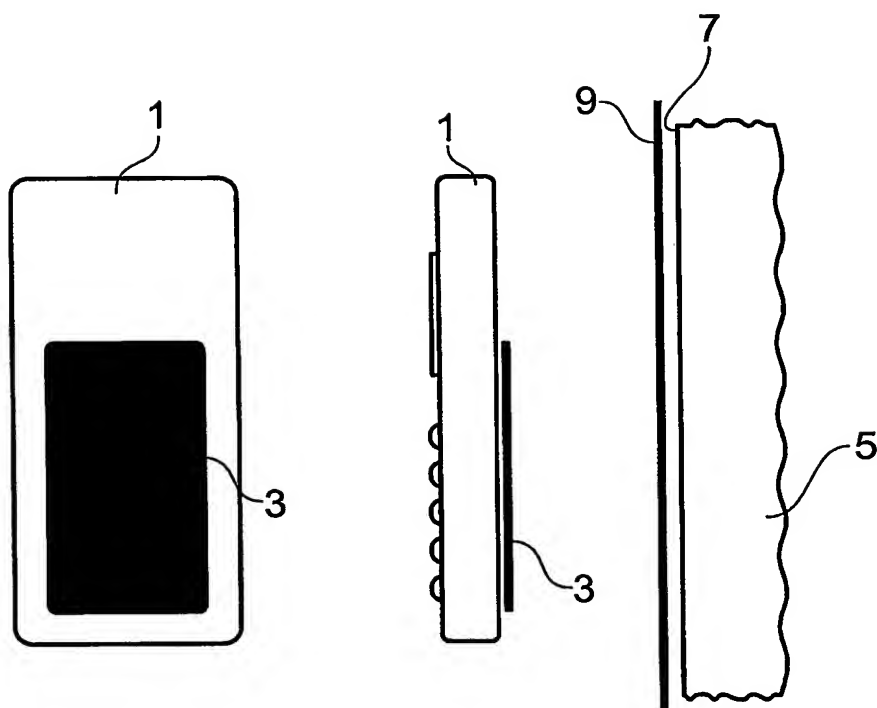


Fig. 3

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property
Organization
International Bureau



28 MAR 2005

(43) International Publication Date
8 April 2004 (08.04.2004)

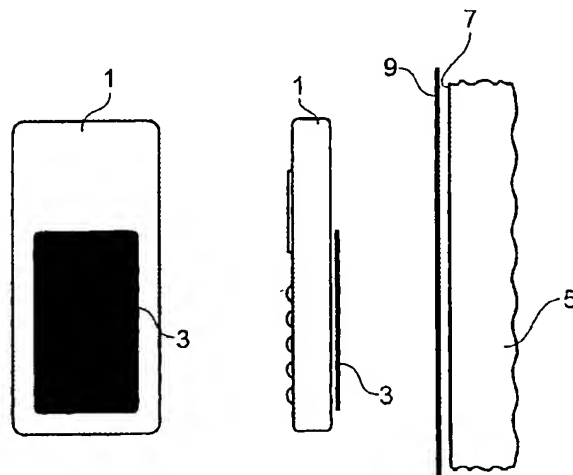
PCT

(10) International Publication Number
WO 2004/030176 A3

- (51) International Patent Classification⁷: H02J 7/02, 5/00 (74) Agent: HASELTINE LAKE; Imperial House, 15-19 Kingsway, London WC2B 6UD (GB).
- (21) International Application Number:
PCT/GB2003/004150 (81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.
- (22) International Filing Date:
26 September 2003 (26.09.2003)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
0222436.8 27 September 2002 (27.09.2002) GB (84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).
- (71) Applicant (*for all designated States except US*): SPLASH-POWER LIMITED [GB/GB]; St. John's Innovation Centre, Cowley Road, Cambridge CB4 0WS (GB).
- (72) Inventors; and
- (75) Inventors/Applicants (*for US only*): BEART, Pilgrim, Giles, William [GB/GB]; 35 Royston Road, Harston, Cambridge CB2 5NI (GB). CHENG, Lily, Ka, Lai [CA/GB]; 53 College Fields, Woodhead Drive, Cambridge CB4 1YZ (GB).
- Declaration under Rule 4.17:
— of inventorship (Rule 4.17(iv)) for US only
- Published:
— with international search report

[Continued on next page]

(54) Title: IMPROVEMENTS RELATING TO RETENTION OF RECHARGEABLE DEVICES



(57) Abstract: There is disclosed a system and method for retaining portable rechargeable devices to recharging stations wherein one or other or both of the recharging station and the portable device are provided with connecting means adapted for temporary releasable connection of the two. This is particularly advantageous when used with recharging stations, which permit the device to be recharged in multiple places on the recharging station, providing a positive means of retaining the device. This is particularly advantageous if the recharging station is to be used in a mobile environment such as a car, or on a wall or ceiling.

WO 2004/030176 A3



(88) Date of publication of the international search report:
9 June 2005

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

INTERNATIONAL SEARCH REPORT

Inter national Application No
PCT/GB 03/04150

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H02J7/02 H02J5/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H02J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,X	US 6 489 745 B1 (KOREIS ROCKE R) 3 December 2002 (2002-12-03) abstract column 1, line 4-6 column 1, line 43 -column 2, line 18 column 2, line 49 -column 3, line 32; figures 1,2	1-12
P,X	US 2003/048254 A1 (HUANG SHIH-SHENG) 13 March 2003 (2003-03-13) abstract paragraph [0002] paragraph [0007] - paragraph [0009] paragraph [0015] - paragraph [0020]; figures 1,2 --- -/--	1-12

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- "&" document member of the same patent family

Date of the actual completion of the international search

21 January 2004

Date of mailing of the international search report

29/01/2004

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 eponi,
Fax: (+31-70) 340-3016

Authorized officer

Lorenzo Feijoo, S

INTERNATIONAL SEARCH REPORT

International Application No.

PCT/GB 03/04150

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 455 466 A (PARKS TERRY J ET AL) 3 October 1995 (1995-10-03) abstract; figures 1,2 column 1, line 6,10 column 2, line 5 - line 50 column 3, line 27 -column 4, line 35 ---	1,3,4,6, 7,9
X	EP 1 213 818 A (SEIKO EPSON CORP) 12 June 2002 (2002-06-12) abstract paragraph [0008] paragraph [0014] - paragraph [0022] paragraph [0069]; figures 1,2 paragraph [0300] ---	1,3,4,6, 7,9
X	US 6 331 744 B1 (WILKERSON BRIAN D ET AL) 18 December 2001 (2001-12-18) abstract; figures 1,2 column 1, line 13 - line 17 column 2, line 53 -column 4, line 62 ---	1-12
X	GB 2 314 470 A (WANG JACK ;TIEN CHUNG LUNG (TW); WANG HUEI MING (TW)) 24 December 1997 (1997-12-24) abstract page 1, line 4 -page 3; figures 1-3 ---	1,4,7,10
X	WO 00 38294 A (ERICSSON INC) 29 June 2000 (2000-06-29) abstract; figures 1,2 page 1-2; figures 1A,2 page 5, line 13 -page 7, line 10 ---	1,3,4,6, 7,9
E	US 6 633 155 B1 (LIANG HUI-PIN) 14 October 2003 (2003-10-14) the whole document ---	1-12
E	GB 2 388 716 A (SPLASHPower LTD) 19 November 2003 (2003-11-19) the whole document ---	1-12
A	US 5 519 262 A (WOOD MARK B) 21 May 1996 (1996-05-21) abstract column 1 -column 2, line 54; claim 8 -----	2,5,8, 10,11

INTERNATIONAL SEARCH REPORT

International application No.
PCT/GB 03/04150

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☒ Claims Nos.: 13-16
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
see FURTHER INFORMATION sheet PCT/ISA/210

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box I.2

Claims Nos.: 13-16

Claims 13-16 have not been searched as they are not allowable under Rule 6.2 (a) PCT.

The applicant's attention is drawn to the fact that claims, or parts of claims, relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB 03/04150

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 6489745	B1	03-12-2002	WO 03023586 A2	20-03-2003
US 2003048254	A1	13-03-2003	TW 535341 B	01-06-2003
US 5455466	A	03-10-1995	NONE	
EP 1213818	A	12-06-2002	EP 1213818 A1	12-06-2002
			US 6316909 B1	13-11-2001
			CN 1272237 T	01-11-2000
			WO 9949552 A1	30-09-1999
			TW 474042 B	21-01-2002
US 6331744	B1	18-12-2001	US 6092531 A	25-07-2000
			US 5945762 A	31-08-1999
			AU 5527601 A	23-10-2001
			EP 1287602 A1	05-03-2003
			JP 2003530809 T	14-10-2003
			WO 0178216 A1	18-10-2001
			US 2003030342 A1	13-02-2003
			US 6281611 B1	28-08-2001
			US 2001045785 A1	29-11-2001
			AU 734234 B2	07-06-2001
			AU 2586699 A	23-08-1999
			CA 2316967 A1	12-08-1999
			EP 1076585 A1	21-02-2001
			JP 2002502642 T	29-01-2002
			WO 9939769 A1	12-08-1999
GB 2314470	A	24-12-1997	NONE	
WO 0038294	A	29-06-2000	US 6288519 B1	11-09-2001
			AU 1630700 A	12-07-2000
			WO 0038294 A2	29-06-2000
			US 2002093309 A1	18-07-2002
US 6633155	B1	14-10-2003	NONE	
GB 2388716	A	19-11-2003	WO 03096512 A2	20-11-2003
			WO 03096361 A1	20-11-2003
			GB 2388715 A	19-11-2003
			US 2003210106 A1	13-11-2003
US 5519262	A	21-05-1996	NONE	